

## Complete Summary

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### GUIDELINE TITLE

Single brain metastasis.

### BIBLIOGRAPHIC SOURCE(S)

Loeffler JS, Bloomer WD, Malcolm AW, Larson D, Gaspar LE, Lewin AA, Mendenhall WM, Schneider JF, Simpson JR, Wharam MD Jr, McDermott MW, Rogers L, Mauch PM, Expert Panel on Radiation Oncology-Brain Metastases Work Group. Single brain metastasis. [online publication]. Reston (VA): American College of Radiology (ACR); 2006. 7 p. [22 references]

### GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Loeffler JS, Bloomer WD, Buckley JA, Gutin PH, Malcolm AW, Schupak KD, Larson D, Gaspar LE, Gibbs FA, Lewin AA, Mendenhall WM, Schneider JF, Shaw EG, Simpson JR, Wharam MD Jr, Rogers L, Leibel S. Solitary brain metastasis. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun; 215(Suppl):1111-20.

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

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## SCOPE

### DISEASE/CONDITION(S)

Single brain metastasis

## GUIDELINE CATEGORY

Treatment

## CLINICAL SPECIALTY

Neurological Surgery  
Neurology  
Oncology  
Radiation Oncology  
Radiology

## INTENDED USERS

Health Plans  
Hospitals  
Managed Care Organizations  
Physicians  
Utilization Management

## GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of radiologic treatment procedures for patients with a single brain metastasis

## TARGET POPULATION

Patients with a single brain metastasis

## INTERVENTIONS AND PRACTICES CONSIDERED

1. Whole brain radiotherapy (WBRT)
  - 2000 cGy/5 fractions
  - 3000 cGy/10 fractions
  - 3750 cGy/15 fractions
  - 4000 cGy/20 fractions
  - 5000 cGy/25 fractions
2. Focal therapy
  - Stereotactic radiosurgery (SRS)
  - Surgical resection
3. Combination therapy
  - SRS and WBRT
  - Surgery and WBRT
4. Observation

## MAJOR OUTCOMES CONSIDERED

- Morbidity or mortality
- Improved care
- Freedom from neurologic progression
- Overall survival

- Quality of life
- Recurrence rate

## METHODOLOGY

### METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

### DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of recent peer-reviewed medical journals, and the major applicable articles were identified and collected.

### NUMBER OF SOURCE DOCUMENTS

The total number of source documents identified as the result of the literature search is not known.

### METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Not Given)

### RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not stated

### METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

### DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

### METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

### DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed for reaching agreement in the formulation of the appropriateness criteria. The American

College of Radiology (ACR) Appropriateness Criteria panels use a modified Delphi technique to arrive at consensus. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1-9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty percent agreement is considered a consensus. This modified Delphi technique enables individual, unbiased expression, is economical, easy to understand, and relatively simple to conduct.

If consensus cannot be reached by the Delphi technique, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible. If "No consensus" appears in the rating column, reasons for this decision are added to the comment sections.

#### RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

#### COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

#### METHOD OF GUIDELINE VALIDATION

Internal Peer Review

#### DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

### RECOMMENDATIONS

#### MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria®

Clinical Condition: Single Brain Metastasis

Variant 1: 48-year-old man status-post left upper lobe for NSCLC two years earlier, now with 3 cm right frontal lobe lesion. No clinical or radiographic evidence of extracranial disease. KPS 2 weeks post-

operatively is 100% . Lesion was completely resected, confirmed by contrast MRI scan 24 hours after surgery.

Treatment	Appropriateness Rating	Comments
Focal Therapy Alone		
Stereotactic radiosurgery (SRS)	5	
Whole Brain RT (WBRT) Alone		
2000/5	1	
3000/10	5	
3750/15	5	
4000/20	2	
5000/25	2	
Observation	5	
Combination Therapy		
SRS + WBRT	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1 = Least appropriate 9 = Most appropriate		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: 35-year-old woman with metastatic breast cancer to multiple boney sites with a 3 cm left parietal lesion. Systemic disease is no longer responding to chemo-hormonal therapy. Surgical resection was subtotal in nature, confirmed by postoperative MRI . KPS 90.

Treatment	Appropriateness Rating	Comments
Focal Therapy Alone		
Stereotactic radiosurgery (SRS)	6	
Surgical resection	1	
Whole Brain RT (WBRT) Alone		
2000/5	1	

Treatment	Appropriateness Rating	Comments
3000/10	6	
3750/15	8	
4000/20	4	
5000/25	1	
Combination Therapy		
SRS + WBRT	3	
Surgery + WBRT	2	
Observation	1	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1 = Least appropriate 9 = Most appropriate		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 3: 77-year-old man, PET scan demonstrated widely metastatic melanoma with a 2 cm right thalamic lesion. KPS 60. Patient refuses experimental immunotherapy.

Treatment	Appropriateness Rating	Comments
Whole Brain RT (WBRT) Alone		
2000/5	8	
3000/10	8	
3750/15	3	
4000/20	2	
5000/25	1	
Focal Therapy Alone		
Stereotactic radiosurgery (SRS)	2	
Surgical resection	1	
Combination Therapy		

Treatment	Appropriateness Rating	Comments
SRS + WBRT	1	
Surgery + WBRT	1	
Observation	1	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1 = Least appropriate 9 = Most appropriate		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 4: 42-year-old woman status-post nephrectomy for renal cell carcinoma six years earlier with a 1 cm lesion in the right lateral cerebellum found incidentally after MRI for head injury. CT of chest/abdomen and bone scan were negative. KPS 100.

Treatment	Appropriateness Rating	Comments
Focal Therapy Alone		
Stereotactic radiosurgery (SRS)	8	
Surgical resection	8	
Whole Brain RT (WBRT) Alone		
2000/5	1	
3000/10	2	
3750/15	3	
4000/20	3	
5000/25	1	
Combination Therapy		
SRS + WBRT	3	
Surgery + WBRT	3	
Observation	1	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1 = Least appropriate 9 = Most appropriate		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 5: 54-year-old man found to have wide spread metastatic small cell carcinoma to lung, bone, and liver by PET imaging with a 2 cm left anterior temporal lobe lesion. KPS 70. Responding to salvage systemic chemotherapy. No prior WBRT.

Treatment	Appropriateness Rating	Comments
Whole Brain RT (WBRT) Alone		
2000/5	2	
3000/10	5	
3750/15	7	
4000/20	2	
5000/25	1	
Focal Therapy Alone		
Stereotactic radiosurgery (SRS)	3	
Surgical resection	2	
Combination Therapy		
SRS + WBRT	2	
Surgery + WBRT	1	
Observation	1	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1 = Least appropriate 9 = Most appropriate		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 6: 68-year-old woman status-post chemotherapy/radiotherapy and surgery for esophageal carcinoma. No evidence of extracranial disease with 5 cm lesion in right anterior frontal lobe with 15 mm midline shift. KPS 90 on high dose steroids.

Treatment	Appropriateness Rating	Comments
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Treatment	Appropriateness Rating	Comments
Focal Therapy Alone		
Stereotactic radiosurgery (SRS)	1	
Surgical resection	5	
Combination Therapy		
SRS + WBRT	1	
Surgery + WBRT	7	
Whole Brain RT (WBRT) Alone		
2000/5	1	
3000/10	1	
3750/15	1	
4000/20	1	
5000/25	1	
Observation	1	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1 = Least appropriate 9 = Most appropriate		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 7: 49-year-old woman (non-smoker) recently diagnosed with 2 cm NSCLC left upper lobe with no hilar and mediastinal lymphadenopathy and asymptomatic 2 cm right frontal lesion. Abdominal CT and bone scan were negative. KPS 100.

Treatment	Appropriateness Rating	Comments
Focal Therapy Alone		
Stereotactic radiosurgery (SRS)	7	
Surgical resection	7	
Combination Therapy		

Treatment	Appropriateness Rating	Comments
SRS + WBRT	6	
Surgery + WBRT	5	
Whole Brain RT (WBRT) Alone		
2000/5	1	
3000/10	2	
3750/15	2	
4000/20	2	
5000/25	1	
Observation	1	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1 = Least appropriate 9 = Most appropriate		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

The appropriate treatment for a patient with a single brain metastasis depends on several clinical factors, including neurologic condition and performance status of the patient. If the patient is suffering from significant mass effect, then surgical resection of the lesion, if feasible, is warranted. For patients with a single lesion who are relatively asymptomatic, the decision process is somewhat more complicated. The aggressiveness of therapy depends on the extent and activity of extracranial disease as well as the patient's general medical condition or performance status. Data indicate that for patients with progressive extracranial disease, surgery plus WBRT is not beneficial compared to WBRT alone. For patients with stable or absent extracranial disease, two randomized studies have clearly shown the benefit of surgical resection followed by WBRT. The benefits are expressed not only in terms of freedom from neurologic progression but also in terms of overall survival. However, a third study, failed to show a survival advantage with the addition of surgery, or an advantage in terms of quality of life. Thus, two of three randomized studies have shown a benefit of surgical resection and WBRT vs. WBRT alone.

The dose used with WBRT in patients with single brain metastasis is based mainly on studies performed in patients with multiple brain metastases. Prospective, randomized phase III clinical trials in patients with multiple brain metastases have included 1000 cGy in one fraction (1000/1), 1200/2, 1800/3, 2000/5, 3000/10, 3600/6, 4000/20, 5000/20, and 5440/34 (160 cGy BID). None of these regimens has proved superior in terms of survival or efficacy (about half of patients have an improvement in their neurologic symptoms); 3000 cGy in 10 fractions or 4000 cGy in 20 fractions represent frequently utilized dose/fractionation schedules. A

randomized trial in patients with one to three brain metastases by the Radiation Therapy Oncology Group (RTOG) used 3750 cGy in 15 fractions WBRT (i.e., 250 cGy per fraction) as the standard treatment arm. This schedule is an extrapolation from two other series in the literature, one of which suggests that 300 cGy fractions given following resection of a single brain metastasis are associated with a greater likelihood of late effects to the normal brain, and another in which prophylactic cranial irradiation given in case of small-cell lung cancer with 250 cGy fractions (10 fractions) was not associated with late effects.

Whether stereotactic radiosurgery can be as effective as surgical resection has not been tested with a Phase III randomization for patients with single brain metastasis. A multi-institutional outcome study was performed on patients treated with radiosurgery and WBRT who met the same entry criteria as the patients treated in the two positive randomized trials of surgery and WBRT vs. WBRT alone. The results of this non-randomized study indicate that radiosurgery plus WBRT produces the same local control, freedom from neurological deterioration, and overall survival as surgery plus WBRT.

Some studies looking at stereotactic interstitial brachytherapy for patients with single lesions indicate that control rates are similar to those obtained with radiosurgery. However, stereotactic brachytherapy is an invasive procedure and requires hospitalization.

The issue of WBRT has been a subject of controversy in the oncology literature for patients with a single brain metastasis. The question of whether surgical resection can be performed without the addition of WBRT has now been put to a Phase III randomized trial that reveals first, that the addition of WBRT to surgical resection produces no overall survival advantage and no increase in the duration of functional independence, and second, that the overall recurrence rate either within the surgically resected area or elsewhere in the central nervous system (CNS) was 47% in patients treated with surgical resection alone versus 10% in patients treated with surgery and WBRT.

The analogous question, of whether radiosurgery can be performed without the addition of WBRT, has been studied retrospectively. Several radiosurgery studies investigating patients treated with radiosurgery alone versus radiosurgery plus WBRT for single and multiple lesions have not shown an improvement in survival with the addition of WBRT. However, an ongoing Japanese study, randomizing patients with one to four brain metastases between radiosurgery and radiosurgery plus WBRT may settle this question.

Another question, whether patients receiving WBRT for a single brain metastasis benefit from the addition of radiosurgery, has recently been answered in a randomized trial in patients with one to three brain metastases. In patients with a single brain metastasis, the addition of radiosurgery increased median survival from 4.9 months to 6.5 months ( $p = 0.04$ ).

Based on current data, surgical resection or radiosurgery alone as the treatment for a single brain metastasis followed by serial radiologic examination of the brain may be appropriate. In patients who receive WBRT, the addition of radiosurgery may increase median survival by several weeks, at the cost of potential WBRT toxicity. In patients who suffer recurrence in either the locally treated region or

elsewhere within the central nervous system, WBRT, focal radiotherapy, radiosurgery, or further surgical resection may be considered. There are no data indicating which of these choices is best.

## Summary

Compelling evidence suggests that aggressive local therapy for patients with single brain metastasis is beneficial for survival. There is also evidence to suggest that aggressive local therapy for a patient with a single lesion improves quality of life. If patients have no evidence of progressive extracranial disease, surgical resection or radiosurgery is appropriate therapy. While it appears that the addition of WBRT does not add to survival or duration of functional independence, it does reduce the risk of further intracranial failure.

## Abbreviations

- CT, computed tomography
- KPS, Karnofsky Performance Status
- MRI, magnetic resonance imaging
- NSCLC, non-small cell lung cancer
- PET, positron-emission tomography
- RT, radiotherapy

## CLINICAL ALGORITHM(S)

Algorithms were not developed from criteria guidelines.

## EVIDENCE SUPPORTING THE RECOMMENDATIONS

### TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

## BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

### POTENTIAL BENEFITS

Selection of appropriate radiologic treatment procedures for patients with a single brain metastasis

### POTENTIAL HARMS

Potential whole brain radiotherapy (WBRT) toxicity

## QUALIFYING STATEMENTS

### QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

## IMPLEMENTATION OF THE GUIDELINE

### DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

### IMPLEMENTATION TOOLS

Personal Digital Assistant (PDA) Downloads

For information about [availability](#), see the "Availability of Companion Documents" and "Patient Resources" fields below.

## INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

### IOM CARE NEED

Getting Better  
Living with Illness

### IOM DOMAIN

Effectiveness

## IDENTIFYING INFORMATION AND AVAILABILITY

### BIBLIOGRAPHIC SOURCE(S)

Loeffler JS, Bloomer WD, Malcolm AW, Larson D, Gasper LE, Lewin AA, Mendenhall WM, Schneider JF, Simpson JR, Wharam MD Jr, McDermott MW,

Rogers L, Mauch PM, Expert Panel on Radiation Oncology-Brain Metastases Work Group. Single brain metastasis. [online publication]. Reston (VA): American College of Radiology (ACR); 2006. 7 p. [22 references]

#### ADAPTATION

Not applicable: The guideline was not adapted from another source.

#### DATE RELEASED

1999 (revised 2006)

#### GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

#### SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

#### GUIDELINE COMMITTEE

Committee on Appropriateness Criteria, Expert Panel on Radiation Oncology-Brain Metastases Work Group

#### COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Panel Members: Jay S. Loeffler, MD; William D. Bloomer, MD; Arnold W. Malcolm, MD; David Larson, MD, PhD; Laurie E. Gaspar, MD, MBA; Alan A. Lewin, MD; William M. Mendenhall, MD; Joseph F. Schneider, MD; Joseph R. Simpson, MD; Moody D. Wharam, Jr., MD; Michael W. McDermott, MD; Lisa Rogers, DO; Peter M. Mauch, MD

#### FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

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#### GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the [American College of Radiology \(ACR\) Web site](#).

ACR Appropriateness Criteria® Anytime, Anywhere™ (PDA application). Available from the [ACR Web site](#).

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

#### AVAILABILITY OF COMPANION DOCUMENTS

The following is available:

- ACR Appropriateness Criteria®. Background and development. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the [American College of Radiology \(ACR\) Web site](#).

#### PATIENT RESOURCES

None available

#### NGC STATUS

This summary was completed by ECRI on January 30, 2001. The information was verified by the guideline developer as of February 20, 2001. This NGC summary was updated by ECRI on August 17, 2006.

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Date Modified: 9/25/2006

